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ABSTRACT

In a study to identify brief forms of the Multidimensional Aptitude Battery (MAB), 30 samples of approximately 250 respondents each were drawn from a population of 4,928 adolescents to evaluate by replicated multivariate regression analyses the best combinations of scales for predicting MAB total scores. MAB subscales measuring Comprehension, Similarities, Digit Symbol, and Spatial were recommended as the best combination for predicting MAB total scores. Advantages and limitations of abbreviated scales are discussed. (Author)

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Brief Form of the Multidimensional Aptitude Battery (MAB)

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Brief Form of the MAB

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Abstract

In a study to identify brief forms of the Multidimensional Aptitude Battery (MAB), 30 samples of approximately 250 respondents each were drawn from a population of 4928 adolescents to evaluate by replicated multivariate regression analyses the best combinations of scales for predicting MAB total scores. MAB subscales measuring Comprehension, Similarities, Digit Symbol, and Spatial were recommended as the best combination for predicting MAB total scores. Advantages and limitations of abbreviated scales are discussed.

Brief Form of the MAB

Timothy D. Hill & Douglas N. Jackson

Almost 90% of research applications of the Weschler Adult Intelligence Scale (WAIS - Wechsler, 1955) have employed an abbreviated form of one kind or another (Holmes, Armstrong, Johnson, & Reis, 1965, p. 1163). An advantage of brief forms is that they permit efficient screening, indicating which cases require a full IQ assessment.

The Multidimensional Aptitude Battery (MAB - Jackson, 1984) is a group administered intelligence test measuring factors very similar to those measured by the Wechsler scales (Stockwell, 1984). Research presented elsewhere (Jackson, 1984) documents the high correlations between total scores and scale scores between the WAIS-R and the MAB. The MAB was developed by applying a series of psychometric guidelines, including several item analyses, designed to foster the content and construct validity of each subscale.

While group testing has been hinted at for the Wechsler scales (cf. Eme and Walker, 1969), this has yet to become a reality. The advent of the MAB, however, brings much of the same information to group or computerized settings, permitting large scale group research and broader applications, which were often prohibitively expensive in the past.

For the reasons provided above, a brief form of the MAB is desirable. The difficulty, is how to make the test shorter. To delete items would force an insufficient sampling of the content domain of each subscale and possibly hinder the "spiral-omnibus"-type scale construction of the battery. Since the MAB is clearly divided into subscales, this research sought to identify a small number of subscales which "best predict" the MAB total scores. Multivariate multiple regression procedures were applied to determine which subscales would be appropriate for a brief form of the MAB. The use of multiple regression in such an application is warranted, and does not pose a threat to the generalizability of the brief form, so long as results are cross validated. To ensure the validity of the prediction equations, substantial validation analyses were performed across thirty random samples, each with a sample size of about 250.

Computational Procedures in Deriving the Brief MAB

The derivation of the brief form(s) of the MAB followed an algorithm for selecting the "best" subset from a set of predictor variables. Essentially, the brief form development followed three steps.

Selection of the "best" predictors. The MAB has 10 subscales, which when summed, produce the total score. Immediately, the problem becomes one of selecting those predictors which are themselves a part of the predicted variable -- itself a linear composite. The augmented data

matrix (predictors and the predicted variable) is impossible to analyze due to perfect multicollinearity. Computer software can determine the best predictors from a larger set of predictors only when there is not perfect multicollinearity. Therefore, the BMDP-9R analysis package was used (with one Verbal and one Performance subscale deleted from analysis), to determine the best subset of predictors. Some forty prediction equations were compared on the basis of their multiple R squared, the adjusted multiple R squared, and Mallow's Cp statistic. Subscales which consistently proved to be the best predictors of the total MAB score in the MAB adolescent normative population (n = 4928) were selected. Two, three and four subscale prediction equations were obtained, which served to identify the best predictors of the full MAB score. They were: Comprehension and Spatial, Comprehension, Digit Symbol and Spatial, and Comprehension, Similarities, Digit Symbol and Spatial, respectively.

Validation of the brief forms. There are essentially two methods of cross-validation, empirical estimation and formula estimation. Murphy (1984) suggests that the differences between cross-validation methods can be one of costs (amount of data, or computing time) or of benefits (in terms of accuracy). Formula estimation requires that the researcher provide some function by which the sample multiple correlation can be adjusted. The latter procedure requires that regression weights be determined in one population-relevant sample, and

then the derived prediction equation be applied to another, equally relevant, sample. The large sample size available in this research assures a good sample size to number of predictors ratio. For cross-validation of the prediction equations, thirty random samples with replacement were produced from the overall MAB normative data pool. Each sample was about 5% of the total (mean size about 250). The small sample size (relative to the population) assured that each random sample would be representative of the population, but not so large as to be likely to have excessive overlap with other random samples. Therefore, the average value of the squared multiple correlation for each prediction equation could be computed across thirty more or less unique samples, and then assessed in terms of its variance and ability to predict total MAB scores.

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Insert Figure 1 About Here

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Figure 1 presents the multiple correlation values for the four variable prediction equation across the thirty validation samples. The fact that there are small variances in the estimates of MAB total scores strongly suggests that the initial selection criteria were adequate. The variances of the mean multiple correlations for the three prediction equations (over 30 validation samples) were all less than 0.001. This stability of the regression formulae suggests that any of the three subscale combinations would serve to portray accurately

the individual's MAB total score.

Predicting the MAB Verbal Score Only

The data analyses reported above have focused on using all MAB subscales to predict the MAB total score. The Verbal subscales (Information, Comprehension, Arithmetic, Similarities, and Vocabulary) do not require pictorial information as do the Performance subscales. This means that the Verbal subscales can be used for special applications such as the assessment of sightless individuals (via the use of audiotaped instructions and items), computerized administration (for computers without adequate screen graphics), and other applications. In this case, the prediction question becomes one of choosing the one or two Verbal subscales which best predict the MAB Verbal score. Experience with the Wechsler scales might suggest that the one (or two) subscales with the highest correlation with the Verbal score be used for prediction. This argument does not consider other important psychometric subscale attributes, for example, scale reliabilties. Using reliability data reported by Jackson (1984, pp. 53-54) together with data from regression analyses, the two best predictors were Comprehension and Similarities. Traditionally, Information and Comprehension Wechsler subscales have been used to predict Wechsler Verbal scores. It was therefore decided to compare the two pairs of subscales, Comprehension and Similarities, and Information and Comprehension, in terms of their relative ability to predict

the MAB Verbal scores. Comparisons were undertaken across the 30 validation samples. (Average sample size was about 250). That is, the squared multiple correlations were compared across 30 data sets. These analyses indicated that there was only a 0.3 % difference in the two methods (in favor of the Information and Comprehension set prediction). Given this evidence, and the higher reliability of Comprehension and Similarities, it is recommended that Comprehension and Similarities should be used to predict MAB Verbal scores. However, the four subscale brief form of the MAB is the recommended form for brief form administration for predicting Full Scale MAB scores.

Discussion

Criticisms have been made in the past regarding abbreviated versions of the Wechsler scales, and it would be well to evaluate these in relation to the brief forms of the MAB. Wechsler (1958) emphasized the subjective and idiosyncratic information that is gained while using the longer WAIS in a clinical setting. Others have criticized brief forms of the Wechsler scales for their loss of information about Verbal/Performance differentiation, subscale variability, and so on. Anastasi (1976) advised that brief forms of the Wechsler scales be used for screening purposes only. Additionally, some brief forms of the Wechsler scales achieved their shorter length by deleting items from each subscale. "Many of the qualitative observations made possible by the

administration of an individual scale are lost when abbreviated scales are used" (Anastasi, 1976, p. 249).

The MAB, as a structured individual or group administered test does not pretend to yield subjective observational material, so the use of a shorter form entails no loss in this regard. The preferred four subscale brief form still yields rough Verbal/Performance differences, with two verbal and two performance scales, albeit at a somewhat lower reliability. If screening is the sole purpose of the adminstration of the brief MAB, then follow up with additional assessment devices is recommended. For research and evaluation of groups of respondents some loss of individual reliability can be justified by the reduced administration time. The objection that there are overlapping elements between predictor and criterion in the present case is not relevant because the relative magnitudes of the part-whole correlations are the issue.

Conclusions

The aim of this research was to derive and validate a brief form of the Multidimensional Aptitude Battery (MAB). Extensive multivariate multiple regression analyses selected the "best" subscales for predicting the MAB total score. The validity of using these subscales to predict MAB total scores was evidenced by the extremely stable squared multiple correlations obtained across 30 random samples from the MAB normative population (n = 250 each). The four subscales were

Comprehension and Similarities (Verbal subscales), and Digit Symbol and Spatial (Performance subscales). The best two subscales to predict MAB Verbal scores were also determined, since special populations or applications require only Verbal MAB administration. The two subscales which are recommended for use as a brief MAB Verbal scale are Comprehension and Similarities.

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Figure 1: STABILITY OF MULTIPLE CORRELATIONS FOR 4 SCALE BRIEF MAB